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Peer-Mediated Instruction and Intervention to Support the Academic Achievement of Secondary Students with Autism Spectrum Disorder: A Systematic Review of the Literature

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The purpose of this paper is to review peer-mediated interventions (PMI) as an effective teaching strategy in supporting the academic achievement of students diagnosed with autism spectrum disorder (ASD) and additional learning needs. Using a systematic review of the literature, eleven (11) peer-reviewed articles met the criteria for inclusion. Results of this search identified four models of PMI that were used to promote on-task academic achievement and increases in correct academic responding. This paper concludes with suggestions for future research and recommendations for implementing peer-mediated interventions in larger inclusive secondary classroom settings.

Key words: autism spectrum disorder (ASD), peer-mediated instruction and interventions (PMI), secondary, academic achievement, academic engagement

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Inclusive secondary classroom settings may provide many benefits for students with autism spectrum disorder (ASD); however, numerous challenges often face secondary students with ASD and their teachers. Large class sizes and higher student to teacher ratios make it difficult for students with ASD to receive the extra support required to be academically successful and secondary teachers do not always deliver the verbal instructions and content delivery that may be required (Osborne & Reed, 2011). In addition, multiple class periods in secondary settings require students to adjust to various teacher routines and expectations throughout the day (Hume et al., 2014). Given the academic challenges and needs of students with ASD in formal learning environments, coupled with difficulties for teachers to provide individualized supports while monitoring student progress amidst growing class sizes, one structural approach to supporting students with ASD in inclusive classrooms is peer-mediated instruction and interventions (PMI). Peer-Mediated Instruction and Intervention (PMI) is an evidenced-based practice that employs the use of typically developing peers who are trained to direct or initiate social approach behaviors to specific target students (Odom & Strain, 1984). Peer-Mediated Instruction and Interventions increase opportunities for students to practice and respond to social and academic material by providing a format in which peers supplement and support instructional material within the classroom. For students with disabilities, including students with ASD, PMIs can be used to embed individualized supports through the use of peers in large inclusive classroom settings with often higher student to teacher ratios.

PMIs are not limited in scope and have been used to support students of all abilities in both academic and social skill developmental areas. In academics, PMIs promote learning by providing students with increases in opportunities to respond and learn through peer observation and modeling. In inclusive classroom settings, PMIs have been used to support elementary students in reading development (Fuchs & Fuchs, 2005), assist in the development of mathematical concepts in both elementary and secondary students identified with specific academic needs (Calhoon & Fuchs, 2003; Fuchs, et al., 1995), and to promote access to general education curriculum for both elementary and secondary students identified with significant disabilities (Carter et al., 2016; Carter et al., 2008). However, to date, there is limited research on the effects of PMIs in supporting the academic achievement of secondary students with ASD

in general education classrooms (Carter et al., 2017). It is the intent of this review of the literature to report on how researchers have used PMI to support academic achievement and social development of students with ASD within general education classrooms and, more specifically, to consider how PMI models were coupled with additional instructional strategies to improve academic and social behaviors of secondary students.

PMI Models Supporting Academic Achievement: Peer Tutoring and Cooperative Learning

The effects of PMIs on academic achievement have been studied for over 30 years (Delquadri et al., 1986; Johnson & Johnson, 1987). Based on the theoretical frameworks of social learning (Bandura, 1977) and cooperative learning (Yager et al., 1985), PMIs used to support academic achievement can be categorized into one of two structural models: (a) peer tutoring models, or (b) cooperative learning models. The structure of a PMI peer tutoring model involves the tutor providing direct instruction to the tutee. Within cooperative learning models, multiple students work together to complete an assignment. These models have been used to encourage the academic achievement of students in general education classroom settings, including but not limited to, students with a range of specific academic disabilities, as well as students with ASD (Delquadri et al., 1986; Fuchs et al., 1997).

Peer Tutoring Models

A peer tutoring format uses a direct (i.e., one on one) reciprocal approach to instruction in order to increase opportunities for students to respond and receive feedback. In the classroom, peer tutoring models are typically structured so that students are paired together with both students taking turns interacting with previously presented material. Both participating peers practice academic content and learn from one another through the observation and modeling of the student identified as the "tutor." Variations in peer tutoring models include: (a) Classwide Tutoring and Peer-Assisted Learning, (b) Same Age and Cross-Age Peer Tutoring, and (c) Peer Supports and Peer Support Arrangements.

Classwide Peer Tutoring and Peer Assisted Learning Models. Classwide Peer Tutoring (CWPT) is the "oldest and most widely researched classwide tutoring model" (Maheady & Gard, 2010, p. 72). CWPT was first developed by Delquadri and colleagues (1983) for the inclusion of students with learning disabilities and specific academic needs in general education classroom

settings. Classwide peer tutoring uses a reciprocal tutoring structure to increase student opportunities to respond, receive mentoring, and provide feedback (Verkamp et al., 2007). Classwide peer tutoring begins with the teacher intentionally pairing all students within the class together and assigning each pair of students to one of two classwide teams. Teachers select peers based on the academic strength of individual students (i.e., higher and lower academic achievement) or aptness of fit (i.e., peers that work well together). Teachers provide each student pair with a set of questions created from previously taught material (e.g., math equations, spelling words, etc.). Each pair of students takes short turns as both the tutor and tutee (e.g., 10 minutes in each role). Classwide peer tutoring utilizes a classwide games format incorporating reinforcement where peer groups work together to earn points. In this format, tutees earn points for correct answers, and tutors provide corrections for incorrect responses. After each student pair has served as both the tutor and tutee, both sets of points earned by peers are added together. Classwide teams combine all points earned by each peer dyad and the team with the most points earns (wins) the reinforcer (e.g., free time class activity).

The Peer Assisted Learning Strategies (PALS) model of PMI was originally developed as a reading intervention for students in grades two through six (Fuchs et al., 1997). The PALS model is based on the classwide peer tutoring model of instruction (Fuchs et al., 1997; McMaster et al., 2006). Teachers begin by ranking students based on reading performance and systematically pairing higher performing students with lower performing students (McMaster et al., 2006). Teachers then train student pairs to engage in a set of structured activities (e.g., reading retell, summarization, prediction, etc.). Similar to CWPT, PALS utilizes a reciprocal method of tutoring where peers take turns acting as both the tutor and tutee. PALS also includes reinforcement and the use of a games-based method of teaching where peers' complete activities together and student pairs work together to earn points for correct responses. The PALS model of instruction has been studied for 20 years and has been adapted to support elementary students in reading acquisition (Fuchs et al., 2001; Fuchs & Fuchs, 2005; Mathes et al., 1998; McMaster et al., 2007) as well as mathematics development in both elementary and secondary settings (Calhoon & Fuchs, 2003; Fuchs et al., 2001; Fuchs et al., 1995). The model has also been applied specifically to support students identified with learning

disabilities (Fuchs et al., 2002; Rafdal et al., 2011), and students identified as English language learners in general education settings (McMaster et al., 2008; Saenz et al., 2005).

Same Age and Cross Age Peer Tutoring Models. Unlike classwide peer tutoring models, same age tutoring and cross age peer tutoring models are individually structured and do not include classwide involvement. In same age and cross age peer tutoring, the tutor (usually more knowledgeable in a particular content area) provides direct academic instruction to a peer (i.e., tutee). Peer tutoring can occur in the classroom or in an outside setting such as a school hallway. Cross age tutoring uses the same instructional format as same age peer tutoring, but older students provide instruction to younger students (Kamps et al., 1999). The use of cross age peer tutoring has been used to support cognitive gains in understanding science concepts in elementary students ages seven and eight years (Topping et al., 2004), to promote mathematics vocabulary acquisition in elementary students ages seven and eight years (Topping et al., 2003), to assist with the development of reading fluency in second grade elementary students with delays in reading (Van Keer & Vanderlinde, 2010; Wright & Cleary, 2006), to develop reading strategy use in third grade students and reading comprehension in sixth grade students serving as the tutors (Van Keer & Vanderlinde, 2010), and to increase overall student attitudes toward reading using fifth grade students with learning disabilities serving as tutors to kindergarteners (Davenport et al., 2004).

Peer Supports and Peer Support Arrangement Models. Peer supports are a unique variation of same-age peer tutoring as they are individually tailored to promote the inclusion of students with significant disabilities in general education classroom settings (Carter et al., 2005; Carter et al., 2009). In a peer support arrangement, one or more peers provide academic, social, and other supports to classmates with disabilities (Brock & Carter, 2016; Carter et al., 2005; Carter et al., 2016). Peer support arrangements are based on individual student needs identified within the student's Individualized Education Program (Brock & Carter, 2016). In a peer support arrangement, special education and general education teachers work together to create a peer support plan. The peer support plan is designed to promote social and academic achievement in general education classrooms (Carter et al., 2009). Structures of peer supports include one-on-one peers working together as well as small groups of students sitting together

in the classroom. In a study on peer support arrangements, Carter and colleagues (2005) found groups of three peers working together were more effective in supporting the on-task engagement of student participants compared to two peers (one-on-one) working alone.

Cooperative Learning Models of PMI

Cooperative learning models also employ the use of classroom peers but are grounded in the theoretical framework of cooperative (i.e., constructive) learning (Johnson & Johnson, 1999). Cooperative learning models are distinguished by peers working together to complete academic tasks and assignments and are particularly effective in the classroom because they provide students with the opportunity to give help and receive help from peers in a private and nonthreatening manner and build a cooperative relationship rather than a tutoring relationship (Artz & Newman, 1990). Cooperative learning formats can be categorized into one of three models: (a) informal cooperative learning, (b) formal cooperative learning, and (c) cooperative based groups (Johnson et al., 1994).

Informal Cooperative Learning Models. This model can be described as "joint learning" occurring when two or more students simply discuss an academic concept together. It is not formal in nature but is used to focus student attention, ensure cognitive processing, and provide closure to teacher directed lessons (Johnson & Johnson, 1994).

Formal Cooperative Learning Models. These models are more structured and can be sustained from one class period up to several weeks (Johnson et al., 1994). Within this structure each student takes responsibility for a particular academic task contributing to the final completion of the assignment. Teachers provide feedback to cooperative groups while monitoring individual student progress.

Cooperative-Based Group Models. These are the most structured of all the cooperative learning models (Johnson et al., 1994). These are applied to the formal structuring of an entire classroom and utilize learning scripts to structure classroom routines and lessons.

PMI Models Applied to Support Students with ASD

While it is clear that peers have been used to assist with instruction in general education settings to affect a variety of academic and social behaviors, the use of PMI models to support the academic achievement of students with ASD is limited. Previously, PMIs have been used to

promote academic engagement and social skills primarily with young children with ASD (Kamps et al., 2015; McCurdy & Cole, 2014). However, to date, there is limited research on the use of PMIs to support the academic achievement of students with ASD in inclusive secondary classroom settings (Brock & Carter, 2016; Carter et al., 2005; 2017). Of these three studies, only one has addressed students with ASD who are without comorbid intellectual disability (Carter et al., 2017).

Several reviews of the literature have been conducted on the effects of PMI models with individuals with ASD (Bene et al., 2014; Chan et al., 2009; Chang & Locke, 2016; Watkins et al., 2015). These literature reviews identify a variety of trends such as: (a) the majority of the studies were conducted in elementary schools or preschool settings (Chang & Locke, 2016), (b) participants were primarily of early elementary or preschool ages (Chan et al., 2009; Chang & Locke, 2016), and (c) these studies examined dependent variables including social skill development, academic instruction, and challenging classroom behaviors described as, inappropriate talking, engagement in stereotypy, and difficulties in times of transitioning (Chan et al., 2009; Chang & Locke, 2016). In addition, given that the most prominent features of ASD are associated with impairments in social communication, it is not surprising that the majority (88%) of studies have measured the effects of PMIs in support of social and communication skills, and not the academic achievement, of young children with ASD (Chan et al., 2009). The average (mean) age of these participants was 7.6 years (Chan et al., 2009).

Similar to PMIs in support of academic achievement, PMIs used to promote social and communication skills employ the use of typically developing peers who were trained to initiate, prompt, and reinforce social interactions with peers with ASD (Odom & Strain, 1984; Odom & Strain, 1986). Two examples of PMI models used in these studies to promote communication and social skill development are peer network systems (Hochman et al., 2015; Kamps et al., 2015; Kamps et al., 2014) and peer monitoring systems (Morrison et al., 2001). These systems combine direct instruction with teacher scripts and visual cues to guide and facilitate social opportunities through the use of small groups, or networks of peers.

Purpose

It is the purpose of this review to (a) identify the ways PMIs have been applied to support the academic achievement of students with ASD and (b) learn the additional strategies (i.e., evidence-based practices) that were used in combination with these PMI models to support academic achievement. Therefore, it is the aim of this review to include the following: (a) peer-mediated intervention models that have been studied supporting the academic achievement of students diagnosed with autism spectrum disorder, (b) areas of academic support (e.g., science, language arts, math), and (c) the context or settings in which the interventions took place and additional components (i.e., evidence-based strategies) that may have been used in combination with these interventions, (d) student participant reports of consumer satisfaction (i.e., social validity), and (e) implications for future practices supporting the academic achievement of students with autism in large secondary classrooms.

Method

Search Criteria

To be included in search parameters, studies needed to be peer-reviewed and report academic achievement as the primary dependent variable in core content areas (e.g., math, science, social science/history, language arts). Student participants needed to be identified with autism spectrum disorder, pervasive developmental disorder not otherwise specified (PDD-NOS), or Asperger's Syndrome. Articles were excluded if the reported primary dependent variable was outside of academic achievement (e.g., social skills) or if content was outside of core academic areas (e.g., physical education, elective courses). Articles were also excluded if the participants were not identified with ASD as a primary disability.

First, a search of peer-reviewed articles using ERIC, Education Source, and PSYCINFO databases was conducted. The keywords used in this search were "autism" or "pervasive developmental disorder (not otherwise specified)" or "Asperger's" and "peer*" and "academic." Second, an independent search was conducted using the key terms "autism" or "pervasive developmental disorder (not otherwise specified)" or "Asperger's." The terms were coupled with the following peer-instructional class models: (a) Cooperative Learning Groups; (b) Classwide Peer Tutoring; (c) Peer Assisted Learning Strategies; (d) Classwide Student Tutoring

Teams, or (e) Peer Support*. Third, an ancestral search was conducted using the references section of relevant articles.

Coding and Procedure

Articles were coded by the type of peer-mediated academic intervention, academic setting of peer-mediated intervention, and academic content area measured as the dependent variable.

Peer-Mediated Academic Intervention

The peer-mediated academic intervention was defined as the peer to peer relationship at the class wide level, small group level, individual peer supports, or other explicitly stated model.

Academic Setting and Age

The academic setting was defined by the physical location where the peer-mediated intervention occurred. Physical locations were categorized as: (a) the general education classroom, (b) special education/self-contained classroom, or (c) outside setting (e.g., hallway or clinical setting). Student participant age was categorized as: (a) preschool (pre-kindergarten), (b) elementary (kindergarten - grade 5), (c) secondary middle (grades 6 - 8), and (d) secondary high school (grades 9 – 12).

Academic Content Area/Dependent Variable

The dependent variable, academic achievement, was categorized in 4 core academic content areas: (a) math, (b) language arts, (c) science, and (d) history/social science.

Results

A total of 11 studies out of a pool of 361 journals met the parameters for inclusive criteria (see Table 1). Results were consistent with the findings of Chan et al. (2009), yielding five additional studies (Brock & Carter, 2016; Carter et al., 2017; Kamps et al., 1989; McCurdy & Cole, 2013; Murphey et al., 2004). Studies conducted by Brock and Carter (2016), Carter et al. (2017) and McCurdy and Cole (2013) were published after 2009. Murphey et al. (2004) conducted a single case AB design without replication. In their review of the literature, Chan et al. (2009) included only studies demonstrating a replicating effect. All 11 studies identified in this review used single-case research designs.

Table 1.

Review of PMI Supporting the Academic Achievement of Students with ASD

Author	Participants	Academic Setting	Intervention	Method of Peer Training	Method	Academic Content (Dependent Variable)	Findings	Social Validity	Additional Instructional Strategies
Kamps et al. (1989)	2 males; autism and intellectual disability; 9 and 11 years old	Isolated self-contained special education classroom (reverse mainstream). No other students present in the classroom	Same-age peer tutors	Direction, modeling, prompting	SCD: multiple baseline across participants	Percentages of correct responses: math (counting coins), verbal expression, and oral reading	Increased performance levels for both students across all three tasks (math, verbal expression, oral reading)	Not reported	Visual Supports (math manipulatives, worksheets, flashcards) Reinforcement (praise) Prompting
Hunt et al. (1994)	Male, autism and severe intellectual disabilities; 7 years old	2nd grade general education classroom	Cooperative Learning Groups	Cues, prompting	SCD: ABAB withdrawal	Pretest and post test scores (numbers of correct responses): geometric shapes (tangrams): parameters, areas, measurement	Increase in group scores at posttest. Increase in correct prompted and independent communication and motor responses	Not reported	Visual Supports (math manipulatives)
Kamps et al. (1994)	3 males; high functioning autism; 8,	3 general education classrooms; 1st second grade	Class wide Peer Tutoring	Class wide training (45-minute sessions	SCD: multiple baseline	Rate of words read correctly per minute, percentages	Increase in mean number of words read correctly and correct responses	Follow up survey interviews of all student	Prompting

Author	Participants	Academic Setting	Intervention	Method of Peer Training	Method	Academic Content (Dependent Variable)	Findings	Social Validity	Additional Instructional Strategies
	8, and 9 years old	split, 2nd grade, 3rd grade		provided 3 times)	across participants	of correct responses to comprehension questions	to reading comprehension questions for all 3 student participants	participants, peers, and teachers	
Kamps et al. (1995)	Experiment 1: 1 male; high functioning autism; 8 years old Experiment 2: 2 females; moderate and lower functioning intellectual disability; 13 and 12 years old	Experiment 1: 3rd grade general education classroom Experiment 2: 5th grade general education classroom	Cooperative Learning Groups	Group training (10 minutes before each session)	SCD: ABAB withdrawal	Weekly pretest and posttest quizzes on reading passages and academic engagement	Experiment 1: Increase in reading gains (vocabulary and comprehension) at grade level and increase in academic engagement Experiment 2: Mixed results. Increase in academic engagement. Variability in weekly quizzes	Consumer satisfaction questionnaires. Follow up surveys administered the last month of school to all participant teachers and student	Visual Supports (organizers, flashcards, game cards) Reinforcement
Dugan et al. (1995)	1 female, 1 male; moderate and high functioning autism; 10 and 9 years old	4th grade general education classroom (social studies)	Cooperative Learning Groups	Group training (40-minute sessions provided 4 days)	SCD: ABAB withdrawal	Weekly pretest and posttest quizzes on social studies curriculum (sight word vocabulary	Increases in pretest and posttest scores (higher in vocabulary recognition) and increases in	Participating teachers completed consumer satisfaction surveys at the end of the study	Visual Supports (activity sheets, flashcards) Reinforcement (sticker chart)

Author	Participants	Academic Setting	Intervention	Method of Peer Training	Method	Academic Content (Dependent Variable)	Findings	Social Validity	Additional Instructional Strategies
						and comprehension)	academic engagement		
Kamps et al. (1999)	1 male; autism; 10 years old	Hallway; elementary school setting	Same Age Peer Tutoring	Role play, modeling, feedback	SCD: ABABA withdrawal	Weekly pretest and posttest quizzes on sight-word reading responses	Increases in sight word recognition	Anecdotal reporting and follow up interviews with teachers	Reinforcement (praise)
Murphy et al., (2004)	1 male; autism; 8 years old	Self-contained special education classroom (reverse mainstream). No other students present in classroom	Cooperative Learning Groups	Group training (10 minutes before presentation of task)	SCD: AB baseline and intervention	On-task engagement. General education science curriculum	Slight decrease in academic engagement	Teachers and parents of student participants were interviewed for intervention validity	Reinforcement (activity for completed tasks, praise)
Carter et al. (2005)	1 male Caucasian, 1 female Caucasian; autism and moderate intellectual disabilities, 12 and 13 years old	6th and 8th grade general education science classes	Peer Support	2 to 4 days of initial training, ongoing feedback	SCD: ABAB, BABA reversal	Academic engagement with the general education curriculum	Higher rates of contact with the curriculum when working with 2 peers versus 1 peer alone for one student participant (male). No differences in contact with the	Not Reported	Prompting

Author	Participants	Academic Setting	Intervention	Method of Peer Training	Method	Academic Content (Dependent Variable)	Findings	Social Validity	Additional Instructional Strategies
							curriculum for the second student participant (female)		
McCurdy & Cole (2014)	3 males; high functioning autism; 8, 7, and 11 years old	3rd, 2nd, and 5th grade general education classes	Peer Support	Role play, modeling	SCD: multiple baseline across participants	Academic engagement (reduction in off-task behaviors) within general education curriculum	Decrease in off-task behaviors for all 3 participants	Intervention acceptability: Teachers completed Intervention Rating Profile-15 (IRP-15). Student participants completed Children's Rating Intervention Profile (CIRP).	Reinforcement (praise)
Brock & Carter (2016)	1 female African American; autism; 10 years old	5th grade, general education science and math block	Peer Support	Initial training, ongoing feedback	SCD: multiple baseline across participants	Academic engagement with the general education curriculum	Consistent academic engagement	Social validity: Questionnaire / survey provided to teachers and paraprofessionals	Reinforcement, prompting

Author	Participants	Academic Setting	Intervention	Method of Peer Training	Method	Academic Content (Dependent Variable)	Findings	Social Validity	Additional Instructional Strategies
Carter et al. (2017)	1 male African American 18 year old, 2 males Caucasian, 17, 16 years old	12th grade business, 11th grade math, 10th grade science, 12th grade	Peer Support	Initial training, ongoing feedback	SCD: multiple baseline across participants (non-concurrent)	Academic engagement with the general education curriculum	Increase in academic engagement for 2 participants, maintenance of academic engagement in 1 participant, decrease in academic engagement in 1 participant	Social validity: survey provided to primary and peer participants	Prompting

PMI Models to Support Academic Achievement of Students with ASD

Of note, the majority of the PMI studies involving students with ASD and specific academic needs involve the use of PMIs to support social skill development. To date, only eleven (11) studies have been conducted using PMI models with students from this population to support their academic achievement, specifically in language arts, math, science, and history/social studies. Of these 11 studies, only three (3) studies have been conducted within secondary settings (Brock & Carter, 2016; Carter et al., 2005; Carter et al., 2017). To better understand the gaps in research when reviewing the literature surrounding the use of PMI strategies with students with ASD and specific learning needs, the results of review will be presented in the following subsections: (a) demographics of student participants, (b) settings of intervention, (c) areas of academic achievement, (d) types of PMI model used in promoting academic achievement, (e) description of additional evidence-based practices included in the study, and (f) reported measures of social validity.

Demographics of Student Participants

A total of 21 participants were included in these studies (16 males, 5 females). Of the 21 students, 13 student participants were described with ASD without an intellectual disability (Brock & Carter, 2016; Carter et al., 2017; Dugan et al., 1995; Kamps et al., 1994; Kamps et al., 1999; Kamps et al., 1995; McCurdy & Cole, 2014; Murphy et al., 2004). Two student participants were described with moderate autism (Dugan et al., 1995; Kamps et al., 1995), and six student participants were described with ASD and an intellectual disability (Carter et al., 2005; Hunt et al., 1994; Kamps et al., 1989; Kamps, 1995). Participants were listed between seven and 18 years of age. Only three studies reported demographic information on student participant's race or ethnicity (Brock & Carter, 2016; Carter et al., 2005; Carter et al., 2017).

Setting of Intervention

The setting of all eleven studies were conducted in traditional (e.g., non-clinical) school settings. While most of the studies (eight) were conducted in elementary schools (kindergarten through 5th grade; Dugan et al., 1995; Hunt et al., 1994; Kamps et al., 1989; Kamps et al., 1994; Kamps et al., 1995; McCurdy & Cole, 2013; Murphy et al., 2004), two studies were conducted in middle school classrooms (Brock & Carter, 2016; Carter et al., 2005) and, of particular note,

only one study was conducted in high school classrooms (Carter et al, 2017). As one would hope, given the nature of the intervention, eight of the studies were conducted in general education classroom settings (Brock & Carter, 2016; Carter et al, 2005; Carter et al., 2017; Dugan et al., 1995; Hunt et al., 1994; Kamps et al., 1995; Kamps et al., 1995; McCurdy & Cole, 2013). Two studies were conducted in self-contained special education elementary classrooms (Kamps et al., 1989; Murphy et al., 2004), and only one study was conducted in an elementary hallway outside of a classroom setting (Kamps et al., 1999). For the studies that were conducted outside of the general education classroom, two studies were conducted within a self-contained special education classroom, referred to as "reverse mainstream" (Kamps et al., 1989; Murphy et al., 2004). These two studies recruited the use of same age typically developing peers who were from general education classrooms to provide instructional intervention to students in a self-contained special education classroom. For the single study conducted in the elementary school hallway setting (Kamps, et al., 1999), the student participants, including participants with ASD, were enrolled in the general education setting and the hallway setting was selected due to a reduction in noise level (distractibility) and lack of an available room within the given elementary school setting.

Measures of Academic Achievement

As mentioned previously, of all the studies examining PMIs used with students with ASD, only 11 of them examined academic achievement as the primary dependent variable. Areas of academic content supported by peer-mediated interventions included math (Carter et al., 2017; Hunt et al., 1994; Kamps et al., 1989), language arts (Kamps et al, 1994; Kamps et al., 1995; Kamps et al., 1999; McCurdy & Cole, 2014), science (Brock & Carter, 2016; Carter et al., 2005; Carter et al., 2017; Murphy et al., 2004), and history/social sciences (Dugan et al., 1995).

Hunt et al. (1994) and Kamps et al. (1989) measured academic achievement using percentages of correct responses through the use of math manipulatives (i.e., counting coins and tangrams). Kamps et al. (1994) and Kamps et al. (1999) compared rates of words read correctly per minute at baseline and after intervention. In addition, three studies measured correct academic responses to comprehension questions (Kamps et al., 1994) and weekly pretest and posttest quizzes (Kamps et al., 1995; Dugan et al., 1995). Kamps et al. (1994)

measured percentages of correct responses to comprehension questions as well as rates of words read correctly per minute with three elementary school students (ages 8, 8, and 9 years). Kamps et al. (1995) created weekly reading passages to measure words read correctly and measured academic engagement in one elementary student (age 8 years) and elementary school students with ASD (ages 13 and 12 years). Dugan et al. (1995) also conducted weekly pretest and posttest quizzes on social studies curriculum content using correct responses in both sight word vocabulary and content comprehension in two students ages 9 and 10 years.

Rather than measuring correct responses, Brock and Carter (2016), Carter et al. (2005), Carter et al. (2017), McCurdy and Cole (2013), and Murphy et al. (2004) measured academic engagement. Given variation in the response rates of students identified with significant disabilities, percentages of academic engagement were used to signify learning. The use of engagement as a parameter of academic achievement is of particular interest as the use of this measure, compared to number of correct responses, may be a more viable alternative in the assessment of achievement and learning of general education curriculum within inclusive classroom settings. Assessments measuring student engagement, rather than correct responses, may provide educators with alternative and more beneficial information regarding the learning process for students with significant learning needs.

Models of PMI Applied to Support Academic Achievement

Four studies were conducted measuring the effects of a peer support arrangement model on the academic engagement of students with ASD and specific academic needs in general education settings (Brock & Carter, 2016, Carter et al., 2005; Carter et al., 2017; McCurdy & Cole, 2013). In addition, four studies measured the effects of cooperative learning groups on the academic achievement of students with ASD and specific academic needs (Dugan et al., 1995; Hunt et al., 1994; Kamps et al., 1995; Murphy et al., 2004). Two studies were conducted measuring the effects of same-age peer tutors on elementary students with ASD (Kamps et al., 1989; Kamps et al., 1999). Kamps and colleagues (1989) studied the effects of same-age peer tutoring in a self-contained classroom in the areas of money counting, expressive language, oral reading, and comprehension. In a similar study, Kamps et al. (1999)

studied the effects of sight word instruction provided by peer tutors on student participant's sight word recognition.

Only one study was conducted measuring the effects of a class wide peer tutoring model (Kamps et al., 1994). In their study, Kamps et al. (1994) examined reading rates and comprehension responses of three elementary students with ASD.

Description of Additional Instructional Strategies in PMI Models

All 11 studies examined the effects of the PMI models as outlined in this review. However, all 11 studies also included interventions beyond the descriptions of the PMI models. For example, four studies described the additional use of visual supports (Dugan et al., 1995; Hunt et al., 1994; Kamps et al., 1989; Kamps et al., 1995). Visual supports in these studies were listed as math manipulatives in both peer tutoring (Kamps et al, 1989) and cooperative learning group models (Hunt et al., 1994). Other visual supports were listed as graphic organizers and flashcards included in cooperative learning group models to support language arts (Kamps et al., 1995) and social studies curriculum (Dugan et al., 1995). Seven studies incorporated peer reinforcement, listed as peer praise (Brock & Carter, 2016; Kamps et al., 1989; Kamps, 1994; Kamps et al., 1999; McCurdy & Cole, 2014; Murphy et al., 2004) tangible reinforcement (Dugan et al., 1995), and a preferred group contingency activity (Murphey et al., 2004). Lastly, four studies included descriptions of peer delivered prompting strategies, used within same-age peer tutoring (Kamps et al., 1989), cross age peer tutoring (Kamps et al., 1995) and peer support model interventions (Carter et al., 2005; Carter et al., 2017). Kamps et al. (1989) and Kamps et al. (1995) trained fourth and fifth grade students in the use of verbal prompts to initiate academic responses in peer tutoring and cross age peer tutoring models (e.g., "How much is this worth?" "What story did you read?"). Brock and Carter (2016) utilized paraprofessional educators to teach typically developing peers in ways to support and verbally prompt and reinforce the academic behaviors of students with ASD. Carter et al (2005) and Carter et al. (2017) also trained typically developing peers in the use of verbal prompting as a method of reengaging student participants in academic tasks and assignments during occurrences of off task behaviors.

Social Validity

Social validity was reported in eight of the eleven studies identified. Measures of social validity were listed as follow up surveys and participant interviews (Brock & Carter, 2016; Carter et al., 2017; Dugan et al., 1995; Kamps et al., 1994; Kamps et al., 1999; Kamps et al., 1995; Murphey et al., 2004), and an intervention rating profile (McCurdy & Cole, 2014). It is important to note that only one study reported one participant negatively responded on one survey question within the high school peer support intervention (Carter et al., 2017). In this study, Carter et al. (2017) reported that one of the four primary participants reported "not wanting to continue hanging out with his peer partners moving forward." Other social validity questions included within this study's survey included, "I felt like I was effective in this role." "I would be a peer support again in the future." "Others in this class should also do this." "I benefitted socially from having a peer support." And, "I benefitted academically from having a peer support."

Discussion

Future Research in PMI Supporting Academic Achievement of Students with ASD

Although limited in study, the literature suggests that PMI structures are effective in supporting the academic engagement of students with ASD across various academic content areas (e.g., math, language arts). Both peer tutoring and cooperative learning models have been found to effectively promote academic achievement and social interactions for students with ASD. However, the literature also highlights areas for future research. Research in peer-mediated interventions supporting students with ASD is greatly needed in secondary settings. To date, only three studies in peer support arrangements (Brock & Carter, 2016; Carter et al., 2005, Carter et al., 2017), have been conducted in supporting the academic achievement of secondary students with ASD in general education settings. Two of these studies (Brock & Carter, 2016; Carter et al., 2005) were conducted in middle school settings and only one study (Carter et al., 2017) was conducted in a high school. Overall, PMIs have been identified as an evidenced-based practice by both the National Professional Development Center on Autism Spectrum Disorders (Wong et al., 2016) and the National Standards Project (NSP, 2015). In the context of inclusive classroom settings, PMIs are particularly effective in providing additional academic supports to students with ASD and specific academic needs while not impacting the instructional demands on the teacher. While PMIs have been effective at increasing academic

engagement and task completion, the practice of using PMIs to support the academic achievement of students with ASD is limited, and as a result, it is difficult to make generalizations regarding the implications of PMIs in secondary classroom settings. PMIs are effective because they: (a) increase the proportion of instructional time, (b) support individual students with additional practice, and (c) provide immediate feedback with error correction (Fuchs et al, 1997).

In supporting the academic achievement of students with ASD and specific academic needs, there are two major areas of research needed in this field: 1) the application of PMI models previously validated as effective for general education students (e.g., Peer Assisted Learning Strategies) extended to support the academic achievement of students with ASD, and 2) the application of additional strategies (i.e., evidence-based practices), that are effective in supporting students with ASD, implemented through peer-mediated interventions. That is, how can PMI be used to increase the implementation of other evidence-based practices to support the academic achievement of students with ASD? For example, in their study on peer support arrangements in supporting students with significant disabilities, Brock et al., (2016) trained paraprofessionals to facilitate typically developing peers in the use of time delay procedures supporting the academic engagement of students with significant disabilities during electives (art and computer classes). In this study, Brock et al. (2016) included one student participant with ASD in a fifth-grade art class. In a similar approach, training peers to model the use of additional evidence-based practices (e.g., self-management, task analysis), may be beneficial in supporting and maintaining an inclusive secondary classroom setting for students with ASD and specific academic needs. Incorporating academic practices that are supportive of these students with ASD in general education settings (e.g., antecedent based instruction, visual supports, self-management) with PMI structures (i.e., prompting, opportunities to respond and receive feedback) will establish a learning environment that is supportive of students with ASD within inclusive secondary classroom settings.

Implications for Secondary Classroom Settings

This review of the literature suggests that secondary students, including students with ASD, will benefit academically from the incorporation of PMI in large classroom settings.

Specifically, this review of the literature demonstrates that the various PMI models are supportive in both student academic engagement and academic responses across various settings.

Given the prevalence of students with ASD, it is highly likely that secondary teachers will have students with ASD enrolled in their classrooms every day. Peer-mediated interventions continue to be a promising strategy for the inclusion of all learners, including students with ASD in large secondary classroom settings. Moreover, PMI has promise for replacing more traditional use of adults as supports or the need for extensive modifications by the teacher. Combining additional instructional strategies (i.e., evidence-based practices), effective in supporting academic achievement (e.g., Self-Regulated Strategy Development; Self-Monitoring) have not been implemented through peer supports to promote the academic achievement of students with ASD in large classroom settings. As a result, future research in the combination of additional evidence-based practices in support of students with ASD is necessary given large student to teacher ratios within secondary classrooms.

Conclusion

Teachers are faced with tremendous challenges to meet the academic and social needs of ALL their students. As classrooms become more heterogeneous in nature due to more inclusive classroom environments, teachers need to become more innovative with their individualized teaching strategies. Research continues in the areas of peer tutoring and cooperative learning models that contribute to increased instructional time additional student practice and student opportunities to respond.

As more research is conducted in the field of secondary educational setting, more will be learned about further application of PMI models once used with general education students that now can be used with students with ASD and additional learning needs. In addition, the search continues for more evidence-based practices (such as positive reinforcement, visual schedules and self-management) that can be effectively applied within the structure of PMI. As more models and strategies prove effective within the inclusive classroom, teachers will be better equipped to create a learning environment in which all members of their diverse student population can actively participate in a productive, academic setting.

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